Spot the difference: Causal contrasts in scientific diagram

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Scientific diagrams have received little attention from integrated history and philosophy of science. Yet our discipline should be acutely interested in them: Diagrams are a prominent feature of actual scientific practice, appearing copiously in laboratory meetings, conference talks and almost all published papers. Moreover, they are connected to some of the core issues in the philosophy of science, such as discovery, confirmation, explanation and representation.

In this talk, four brief case studies from the life sciences are used to examine one of the key functions of diagrams: identifying causal relationships. This commonly relies on visual contrasts that highlight the effects of specific difference-makers. The case studies cover a wide range of approaches, from experimental to observational and even purely theoretical studies. They show that causal contrasts can be expressed in starkly different formats, including photographs of complexly visualized macromolecules as well as line graphs, bar graphs, or plots of state spaces. However, despite surface differences there is a measure of conceptual unity among such diagrams. In empirical studies they generally serve not only to generate understanding of specific causal claims, but also as evidence for them. Frequently, some of a studys key data is given nowhere except for the diagrams. Many diagrams show multiple causal contrasts in order to demonstrate both that an effect exists and that the effect is specific that is, to narrowly circumscribe the phenomenon to be explained. In all cases examined here, causal contrast diagrams can be shown to reflect the core epistemic project of the research reports in which they appear. This explains a piece of informal advice that most science students receive from their advisors: when reading a paper, start with the figures.

The conclusions give an overview of how integrated history and philosophy of science can use its unique strengths to explore scientific diagrams further. By asking appropriate conceptual questions of detailed historical case studies, we can begin to connect the diverse functions of diagrams in a systematic, historically insightful account.